REMARKS

Claims 1-6 are pending in the present application. The Office Action and cited references have been considered. Favorable reconsideration is respectfully requested.

Prior to addressing the merits of the Office Action, applicants provide the following comments.

The present invention provides a method and a voice-operated system capable of applying noise spectral subtraction on a compressed digital voice signal, without a need for reconstructing the voice signal from the compressed signal. This technique simplifies and reduces the computation needed for the final reconstruction of the voice signal. The need for this method is highly evident, for example, in a mobile phone. In this appliance, the computational resources might be very low, the input voice signal to the speech recognition system is often digitally compressed, and the environmental noise can be an important factor.

The technique of the present invention, aimed at reducing noise in a voice signal, utilizes processing a digital representation of the voice signal by applying thereto linear prediction coding (LPC) analysis to thereby obtain a compressed digital signal, and then applying a spectral subtraction to the compressed digital signal by determining a

power spectrum of the noise component. It is important to note that the technique of the present invention does not utilize reconstruction of the compressed signal, but rather processing of the LPC representation of the compressed signal.

The claims of the present application have been amended to clarify the above features of the invention, and therefore more sharply distinguish them from the cited references.

Turning now to the rejections, claims 1-4 under 35 U.S.C. 102(b) were rejected as being anticipated by Zhao et al. This rejection is respectfully traversed.

Claim 1 recites a method for reducing noise in a voice signal, the method comprising (a) processing a digital signal representative of the voice signal including a speech component and a noise component, the processing comprising applying linear prediction coding (LPC) analysis to the digital signal thereby obtaining a compressed digital signal representative of said voice signal; and (b) processing the compressed digital signal for determining a power spectrum of the noise component, thereby enabling to subtract the noise component from the compressed digital signal. This is not taught, disclosed or made obvious by the prior art.

Contrary to the present invention, the technique of Zhao et al does not utilize a spectral subtraction method.

This is clear from the description of Zhao et al (see for example, page 3, paragraph 2). The term "power" used in Zhao et al (page 3, paragraph 2.1(i)) does not signify "power spectrum" as used in the present invention. The technique of Zhao et al is based on the auto-correlation sequence, where the auto-correlation output R(0) is supposedly estimated directly from the speech signal (see for example, page 3, paragraph 2, equation 3). This is contrary to the present invention, which use an LPC-based compressed signal. Moreover, contrary to the present invention, the technique of Zhao et al, refers only to white noise, and therefore compensates only R(0) for noise (see for example, page 3, paragraph 2, equation 4).

For at least these reasons, applicant respectfully submits that the present invention as claimed in claims 1 and 4 is not disclosed in Zhao et al and is therefore patentable over Zhao et al.

Claim 5 was rejected under 35 U.S.C. 102(b) as being anticipated by Kimura. This rejection is respectfully traversed.

Claim 5 recites a voice processing unit for use in a voice operated system, the voice processing unit comprising a noise reduction utility interconnected between a voice coding utility and a voice recognition utility, the voice coding

utility being configured and operable to process a digital signal representative of an input voice signal, including a speech component and a noise component, by applying linear prediction coding (LPC) analysis to said digital signal thereby obtaining a compressed digital signal representative of said input voice signal, the noise reduction utility being configured and operable for receiving the compressed digital signal, processing it to determine a power spectrum of the noise component, and generating an output compressed digital signal with reduced noise spectrum.

However, the technique of Kimura utilizes spectral subtraction method applied to the original spectrum, and not a noise power estimation from the LPC compressed digital signal. In this connection, Kimura refers to the technique of Boll (reference 3), which is a standard spectral subtraction technique, that does not use the LPC analysis to produce a digital compressed signal and does not use further processing of the LPC results to determine a power spectrum of the noise component. The use of such a standard spectral subtraction approach in Kimura is further supported by Fig. 11.

Thus, Kimura does not disclose the use of a voice coding utility configured and operable to process a digital signal representative of an input voice signal, including a speech component and a noise component, by applying linear

prediction coding (LPC) analysis to the digital signal thereby obtaining a compressed digital signal representative of the input voice signal; and a noise reduction utility configured and operable for receiving the compressed digital signal, processing it to determine a power spectrum of the noise component, and generating an output compressed digital signal with reduced noise spectrum.

For at least these reasons, applicant respectfully submits that the combination of features of claim 5 is not disclosed in Kimura and is therefore patentable over this reference.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. patent 6,003,004 to Hershkovitz et al, in view of Kimura. This rejection is respectfully traversed.

Claim 6 states a voice operated system comprising: an input port for receiving an input voice signal; an analog-to-digital converter for processing the input signal to generate a digital output indicative thereof; a voice processing utility for processing the digital signal by applying thereto linear prediction coding (LPC) analysis and generating a compressed digital signal, representative of the input voice signal, the compressed digital signal being in the form of a set of LPC coefficients and a residual signal; a voice processing unit; a system interface utility; and a

control module, which is interconnected between the voice processing utility and the voice processing unit, and is connected to the system interface to operate it in response to a speech signal; the voice processing unit comprising a noise reduction utility coupled to the voice processing utility for processing said compressed digital signal to determine a power spectrum of the noise component, and generating an output compressed digital signal with reduced noise spectrum; and a voice recognition utility coupled to the noise reduction utility for processing the output compressed digital signal with reduced noise spectrum.

Hershkovits et al disclose a speech recognition method using compressed speech data. This technique, contrary to that of the present invention, as well as to that of Kimura, deals with efficient feature extraction for speech recognition, without reconstructing the vocoder data. Thus, the technique of Hershkovits and Kimura cannot be combined, and moreover, even if such combination would be possible it would not result in the present invention. Hence, the subject matter of claim 6 cannot be learned from a combination of the disclosures in Hershkovits et al and Kimura.

For at least these reasons, applicant respectfully requests reconsideration and withdrawal of the outstanding rejections of record. Applicant submits that the application

is in condition for allowance and early notice to this effect is most earnestly solicited.

If the examiner has any questions, he is invited to contact the undersigned at (202) 628-5197.

Respectfully submitted,

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